

CLAIMS

We claim:

1. A polyester composition for calendering, comprising:
 - (a) a polyester comprising diacid residues, diol residues, and branching monomer residues, wherein said polyester is a random copolymer having a crystallization half time from a molten state of at least 5 minutes and an inherent viscosity of about 0.55 to about 0.75 deciliters/gram (dL/g); and
 - (b) an additive effective to prevent sticking of said polyester to calendering rolls.
2. The polyester composition of claim 1 wherein (i) said diacid residues comprise at least 80 mole percent, based on the total moles of diacid residues, of one or more residues of: terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, or isophthalic acid; and (ii) said diol residues comprise about 10 to about 100 mole percent, based on the total moles of diol residues, of the residues of 1,4-cyclohexanedimethanol and 0 to about 90 mole percent of one or more residues of: ethylene glycol, 1,2-propanediol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, neopentyl glycol, diethylene glycol, 1,6-hexanediol, 1,8-octanediol, 2,2,4-trimethyl-1,3-pentanediol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, 1,3-cyclohexanedimethanol, bisphenol A, or polyalkylene glycol.
3. The polyester composition of claim 2 wherein said diol residues comprise about 10 to about 100 mole percent of the residues of 1,4-cyclohexanedimethanol and 0 to about 90 mole percent of the residues of ethylene glycol.
4. The polyester composition of claim 3 wherein said diacid residues further comprise 0 to about 20 mole percent of one or more residues of modifying diacids containing about 4 to about 40 carbon atoms.

5. The polyester composition of claim 4 wherein said modifying diacid comprises one or more of: succinic acid, glutaric acid, adipic acid, suberic acid, sebacic acid, azelaic acid, dimer acid, or sulfoisophthalic acid.
6. The polyester composition of claim 5 wherein said branching monomer residues comprise about 0.05 to about 1 weight percent (wt%), based on the total weight of said polyester, of one or more residues of monomers having 3 or more carboxyl substituents, hydroxyl substituents, or a combination thereof.
7. The polyester composition of claim 6 wherein said branching monomer residues comprise about 0.1 to about 0.7 mole percent of one or more residues of: trimellitic anhydride, pyromellitic dianhydride, glycerol, sorbitol, 1,2,6-hexanetriol, pentaerythritol, trimethylolethane, or trimesic acid.
8. The polyester composition of claim 7 wherein said additive comprises about 0.1 wt% to about 10 wt%, based on the total weight of said polyester composition, of one or more fatty acid amides, metal salts of organic acids, fatty acids, fatty acid salts, fatty acid esters, hydrocarbon waxes, ester waxes, phosphoric acid esters, chemically modified polyolefin waxes; glycerin esters, talc, or acrylic copolymers.
9. The polyester composition of claim 8 wherein said additive comprises one or more of: erucylamide, stearamide, calcium stearate, zinc stearate, stearic acid, montanic acid, montanic acid esters, montanic acid salts, oleic acid, palmitic acid, paraffin wax, polyethylene waxes, polypropylene waxes, carnauba wax, glycerol monostearate, or glycerol distearate.
10. The polyester composition of claim 9 wherein said crystallization half time of said polyester is at least 12 minutes.
11. The polyester composition of claim 10 wherein said crystallization half time is at least 30 minutes.

12. A polyester composition for calendering, comprising:
- (a) a polyester having a crystallization half time from a molten state of at least 30 minutes and an inherent viscosity of about 0.55 to about 0.70 dL/g, wherein said polyester is a random copolymer comprising
 - (i) diacid residues comprising at least 90 mole percent, based on the total moles of diacid residues, of one or more residues of: terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, or isophthalic acid;
 - (ii) diol residues comprising about 20 to about 70 mole percent, based on the total moles of diol residues, of one or more residues of: 1,4-cyclohexanedimethanol, neopentyl glycol, or diethylene glycol, and about 30 to about 80 mole percent of the residues of one or more diols selected from ethylene glycol, 1,2-propanediol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, 1,8-octanediol, 2,2,4-trimethyl-1,3-pentanediol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, 1,3-cyclohexanedimethanol, bisphenol A, and polyalkylene glycol; and
 - (iii) branching monomer residues comprising about 0.05 to about 0.7 wt%, based on the total weight of said polyester, of one or more residues of: trimellitic anhydride, pyromellitic dianhydride, glycerol, sorbitol, 1,2,6-hexanetriol, pentaerythritol, trimethylol-ethane, or trimesic acid; and
 - (b) about 0.1 wt% to about 10 wt%, based on the total weight of said polyester composition, of an additive effective to prevent sticking of said polyester to calendering rolls, wherein said additive comprises one or more fatty acid amides, metal salts of organic acids, fatty acids, fatty acid salts, fatty acid esters, hydrocarbon waxes, ester waxes, phosphoric acid esters, chemically modified polyolefin waxes; glycerin esters, talc, or acrylic copolymers.
13. The polyester composition of claim 12 wherein said additive comprises (i) a fatty acid or a salt of a fatty acid containing more than 18 carbon atoms and (ii) an ester

wax comprising a fatty acid residue containing more than 18 carbon atoms with an alcohol residue containing from 2 to 28 carbon atoms, wherein the ratio of said fatty acid or said salt of a fatty acid to said ester wax is 1:1 or greater.

14. The polyester composition of claim 13 wherein said fatty acid comprises montanic acid; said salt of a fatty acid comprises one or more of: the sodium salt of montanic acid, the calcium salt of montanic acid, or the lithium salt of montanic acid; and said fatty acid residue of said ester wax comprises montanic acid.
15. The polyester composition of claim 12 further comprising a plasticizer comprising one or more aromatic rings wherein said plasticizer dissolves a 5-mil (.127 mm) thick film of said polyester to produce a clear solution at a temperature of 160°C or less.
16. The polyester composition of claim 15 wherein said plasticizer comprises diethylene glycol dibenzoate.
17. The polyester composition of claim 12 further comprising about 5 to about 40 wt%, based on the total weight of said polyester composition, of a flame retardant comprising one or more monoesters, diesters, or triesters of phosphoric acid wherein said flame retardant is miscible with said polyester.
18. The polyester composition of claim 17 wherein said flame retardant comprises resorcinol bis(diphenyl phosphate).
19. A process for film or sheet, comprising calendering a polyester composition comprising:
 - (a) a polyester having a crystallization half time from a molten state of at least 30 minutes and an inherent viscosity of about 0.55 to about 0.75 dL/g, wherein said polyester is a random copolymer comprising
 - (i) diacid residues comprising at least 80 mole percent, based on the total moles of diacid residues, of one or more residues of:

terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, or isophthalic acid;

- (ii) diol residues comprising about 10 to about 100 mole percent, based on the total moles of diol residues, of the residues of 1,4-cyclohexanedimethanol and 0 to about 90 mole percent of the residues of one or more diols selected from ethylene glycol, 1,2-propanediol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, neopentyl glycol, diethylene glycol, 1,6-hexanediol, 1,8-octanediol, 2,2,4-trimethyl-1,3-pentanediol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, 1,3-cyclohexanedimethanol, bisphenol A, and polyalkylene glycol; and
 - (iii) branching monomer residues comprising about 0.05 to about 1 weight percent (wt%), based on the total weight of said polyester, of the residues of one or more of monomers having 3 or more carboxyl substituents, hydroxyl substituents, or a combination thereof; and
- (b) an additive effective to prevent sticking of said polyester to calendering rolls.

20. The process of claim 19 wherein said branching monomer residues comprise 0.1 to about 0.7 mole percent of one or more residues of: trimellitic anhydride, pyromellitic dianhydride, glycerol, sorbitol, 1,2,6-hexanetriol, pentaerythritol, trimethylolethane, or trimesic acid and said polyester composition has an inherent viscosity of about 0.55 to about 0.7 dL/g.
21. The process of claim 20 wherein said diol residues comprise about 10 to about 100 mole percent of the residues of 1,4-cyclohexanedimethanol and 0 to about 90 mole percent of the residues of ethylene glycol.
22. The polyester composition of claim 21 wherein said diol residues comprise about 20 to about 80 mole percent of the residues of 1,4-cyclohexanedimethanol and about 20 to about 80 mole percent of the residues of ethylene glycol.

23. The process of claim 22 wherein said diacid residues comprise about 95 to 100 mole percent of the residues of terephthalic acid and said diol residues comprise about 20 to 65 mole percent of the residues of 1,4-cyclohexanedimethanol.
24. The process of claim 20 wherein said diacid residues further comprise 0 to about 20 mole percent of one or more residues of modifying diacids containing about 4 to about 40 carbon atoms.
25. The process of claim 24 wherein said modifying diacids comprise one or more of: succinic acid, glutaric acid, adipic acid, suberic acid, sebacic acid, azelaic acid, dimer acid, or sulfoisophthalic acid.
26. The process of claim 20 wherein said additive comprises about 0.1 wt% to about 10 wt%, based on the total weight of said polyester composition, of one or more fatty acid amides, metal salts of organic acids, fatty acids, fatty acid salts, fatty acid esters, hydrocarbon waxes, ester waxes, phosphoric acid esters, chemically modified polyolefin waxes; glycerin esters, talc, or acrylic copolymers.
27. The process of claim 26 wherein said additive comprises one or more of: erucylamide, stearamide, calcium stearate, zinc stearate, stearic acid, montanic acid, montanic acid esters, montanic acid salts, oleic acid, palmitic acid, paraffin wax, polyethylene waxes, polypropylene waxes, carnauba wax, glycerol monostearate, or glycerol distearate.
28. The process of claim 27 further comprising a plasticizer comprising one or more aromatic rings wherein said plasticizer dissolves a 5-mil (.127 mm) thick film of said polyester to produce a clear solution at a temperature of 160°C or less.
29. The process of claim 28 wherein said plasticizer comprises diethylene glycol dibenzoate.

30. The process of claim 20 further comprising about 5 to about 40 wt%, based on the total weight of said polyester composition, of a flame retardant comprising one or more monoesters, diesters, or triesters of phosphoric acid.
31. The process of claim 30 wherein said flame retardant comprises resorcinol bis(diphenyl phosphate).
32. A film or sheet, comprising:
 - (a) a polyester having a crystallization half time from a molten state of at least 30 minutes and an inherent viscosity of about 0.55 to about 0.70 dL/g, wherein said polyester is a random copolymer comprising
 - (i) diacid residues comprising at least 90 mole percent, based on the total moles of diacid residues, of one or more residues of: terephthalic acid, naphthalenedicarboxylic acid, 1,4-cyclohexanedicarboxylic acid, or isophthalic acid;
 - (ii) diol residues comprising about 10 to about 100 mole percent, based on the total moles of diol residues, of one or more residues of: 1,4-cyclohexanedimethanol, neopentyl glycol, or diethylene glycol, and 0 to about 90 mole percent of one or more residues of diols selected from ethylene glycol, 1,2-propanediol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, 1,8-octanediol, 2,2,4-trimethyl-1,3-pentanediol, 2,2,4,4-tetramethyl-1,3-cyclobutanediol, 1,3-cyclohexanedimethanol, bisphenol A, and polyalkylene glycol; and
 - (iii) branching monomer residues comprising about 0.05 to about 0.7 wt%, based on the total weight of said polyester, of one or more residues of: trimellitic anhydride, pyromellitic dianhydride, glycerol, sorbitol, 1,2,6-hexanetriol, pentaerythritol, trimethylolethane, or trimesic acid; and
 - (b) about 0.1 wt% to about 10 wt%, based on the total weight of said polyester composition, of an additive effective to prevent sticking of said polyester to calendering rolls, wherein said additive comprises one or more

fatty acid amides, metal salts of organic acids, fatty acids, fatty acid salts, fatty acid esters, hydrocarbon waxes, ester waxes, phosphoric acid esters, chemically modified polyolefin waxes; glycerin esters, talc, or acrylic copolymers;

wherein said film or sheet is prepared by a calendering process.

33. The film or sheet prepared by the process of any one of claims 21, 22, or 25-31.